

2001: Space Discovery

NASA/JPL 7th Annual Space Science
Symposium for Small Business

Tom Prince
Chief Scientist, JPL

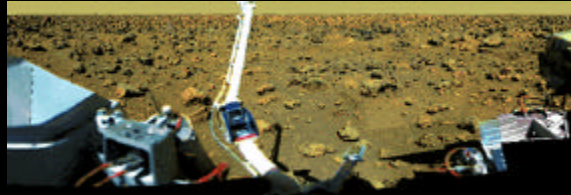
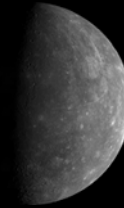
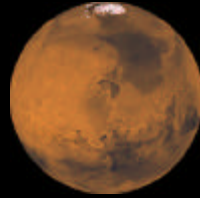
March 5, 2002



Forty Years of Solar System Exploration



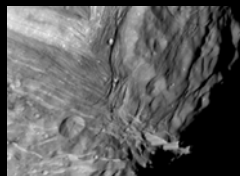
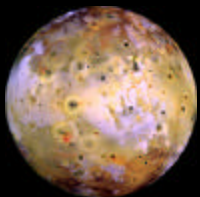
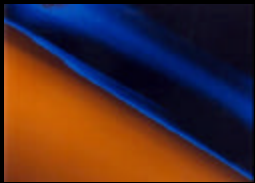
Asteroids



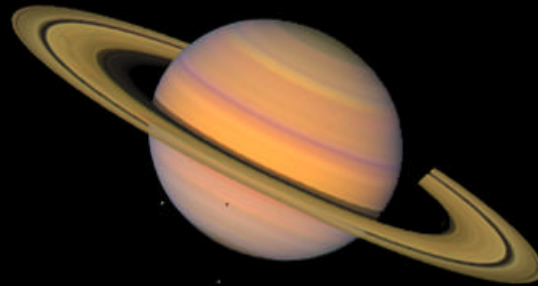
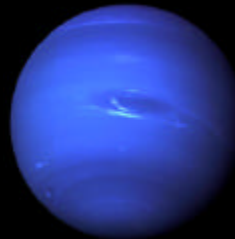
Terrestrial Planets



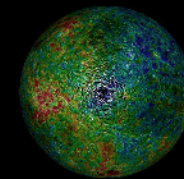
Comets



Planetary Satellites



Giant Planets



The Moon

The Solar System Exploration Program

... seeks answers to fundamental questions about the Solar System and life:

How do planets form?

Why are planets different from one another?

Where did the makings of life come from?

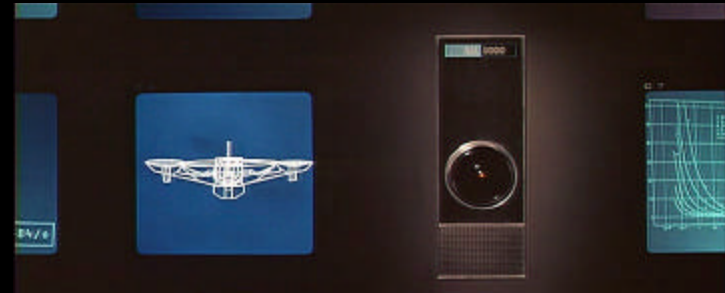
Did life arise elsewhere in the Solar System?

What is the future habitability of Earth and other planets?

2001: A Space Odyssey [Fiction]



Discovery



HAL



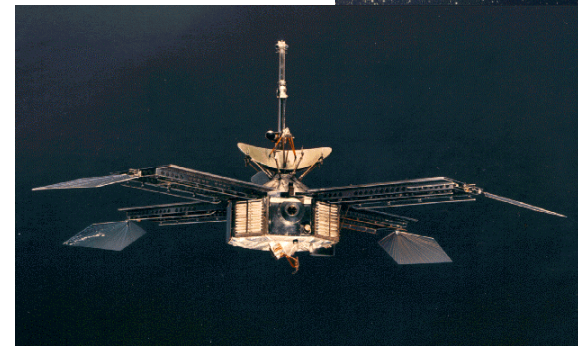
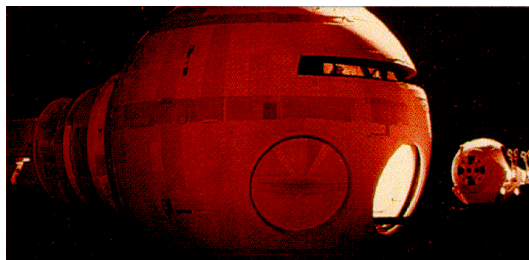
Clarke and Kubrick - 1968

Early Solar System Exploration

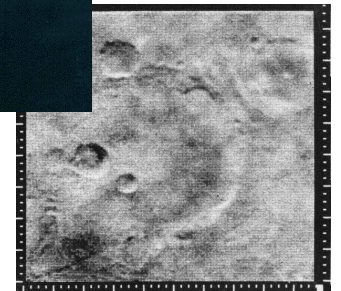
40+2 years of planetary probes

- 1960: 2 attempted Mars flybys (Soviet)
- 1961: 2 attempted Venus probes (Soviet)
- 1962: 4 attempted Venus flybys (US+Soviet)
 - 2 attempted Mars flybys (Soviet)
 - 1 attempted Mars lander (Soviet)
 - Successful Venus flyby (US-Mariner 2)**
- 1963-4: 4 attempted Venus flybys (Soviet)
 - 2 attempted Mars flybys (US+Soviet)
 - Successful Mars flyby (US-Mariner 4)**
- ~1964: Clarke and Kubrick start 2001 film project

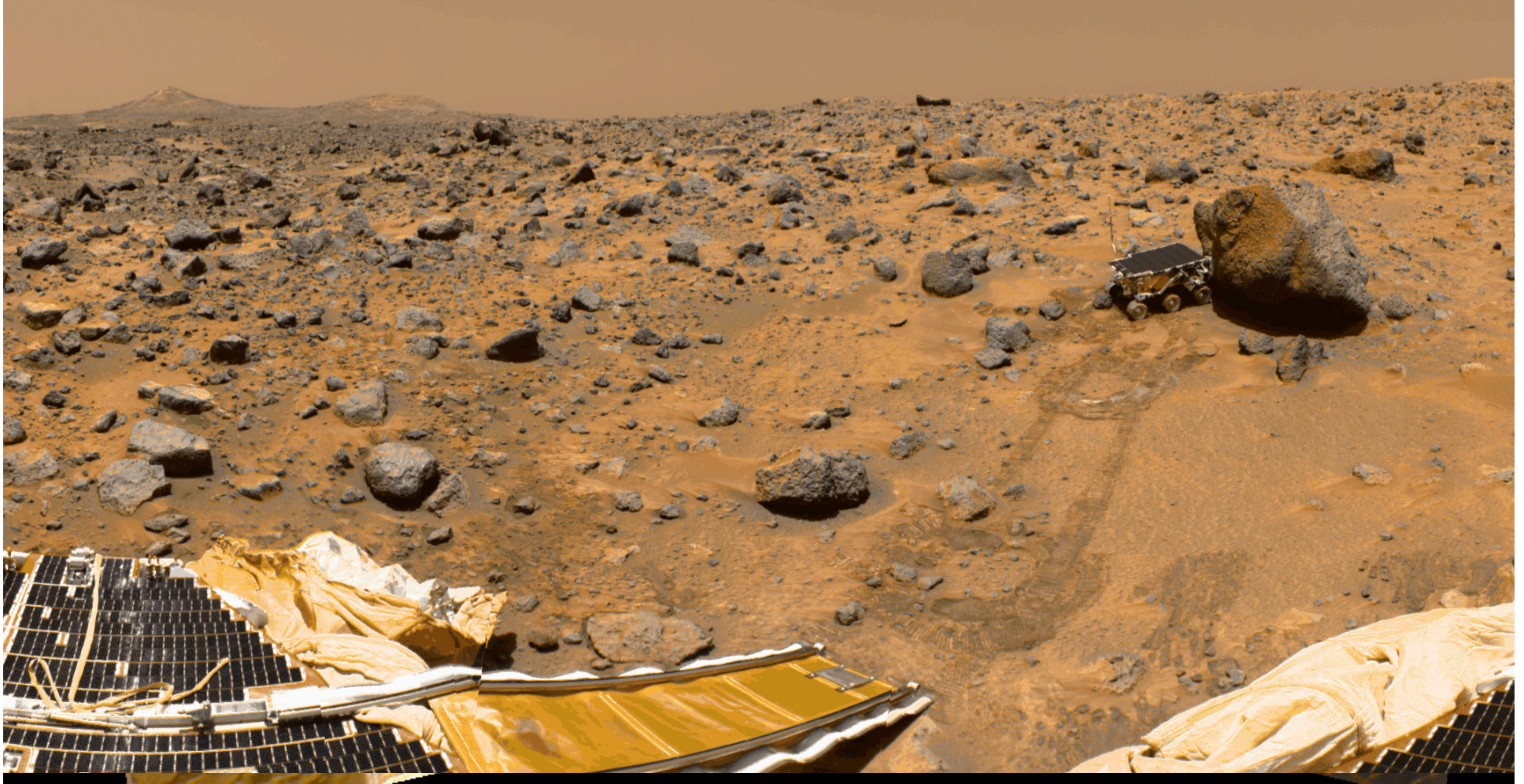
Mariner 2



Mariner 4

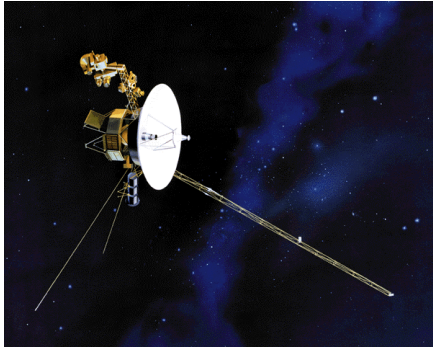


Mars Pathfinder - 1996

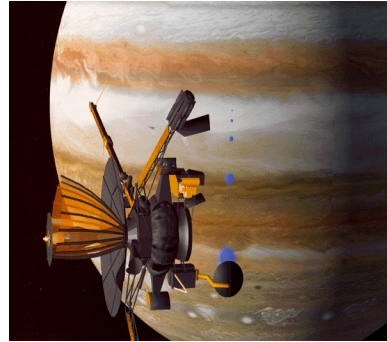


2001: Space Discovery [Fact]

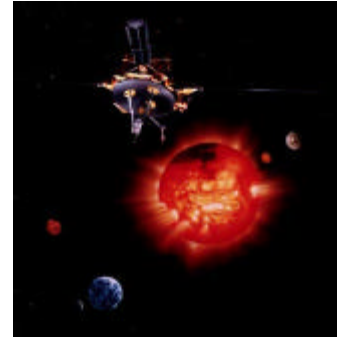
JPL Missions Currently Flying



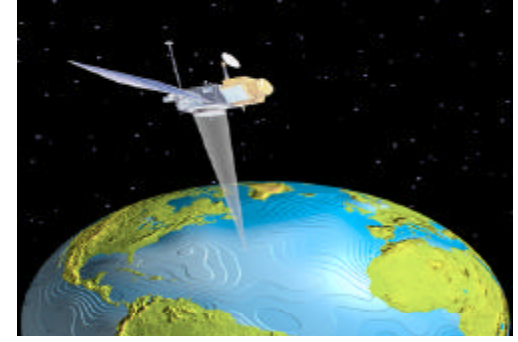
Voyagers 1 & 2



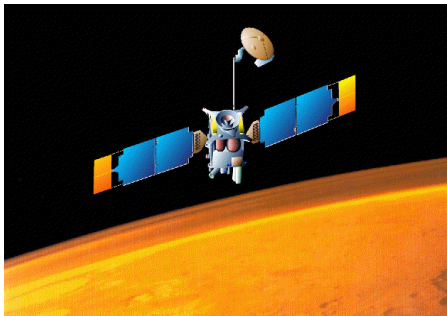
Galileo



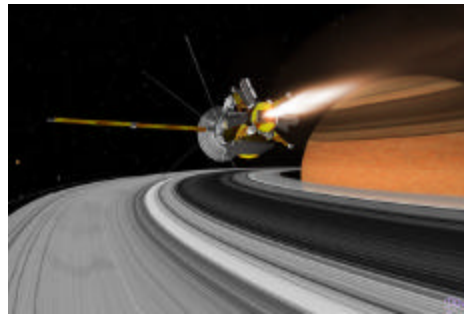
Ulysses



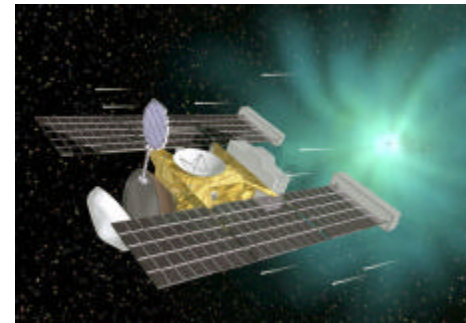
Topex/Poseidon



Mars Global Surveyor



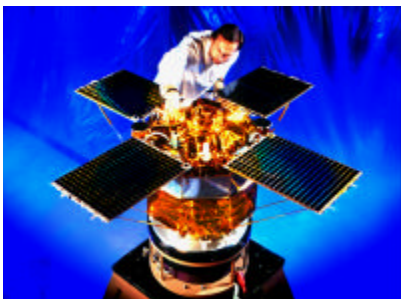
Cassini



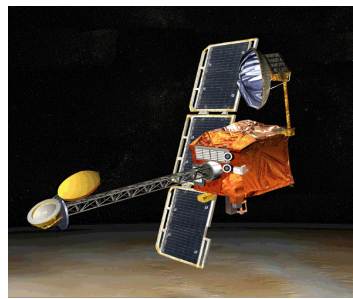
Stardust



Quikscat



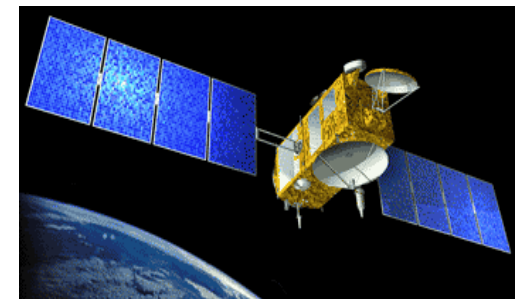
ACRIMSAT



Mars Odyssey



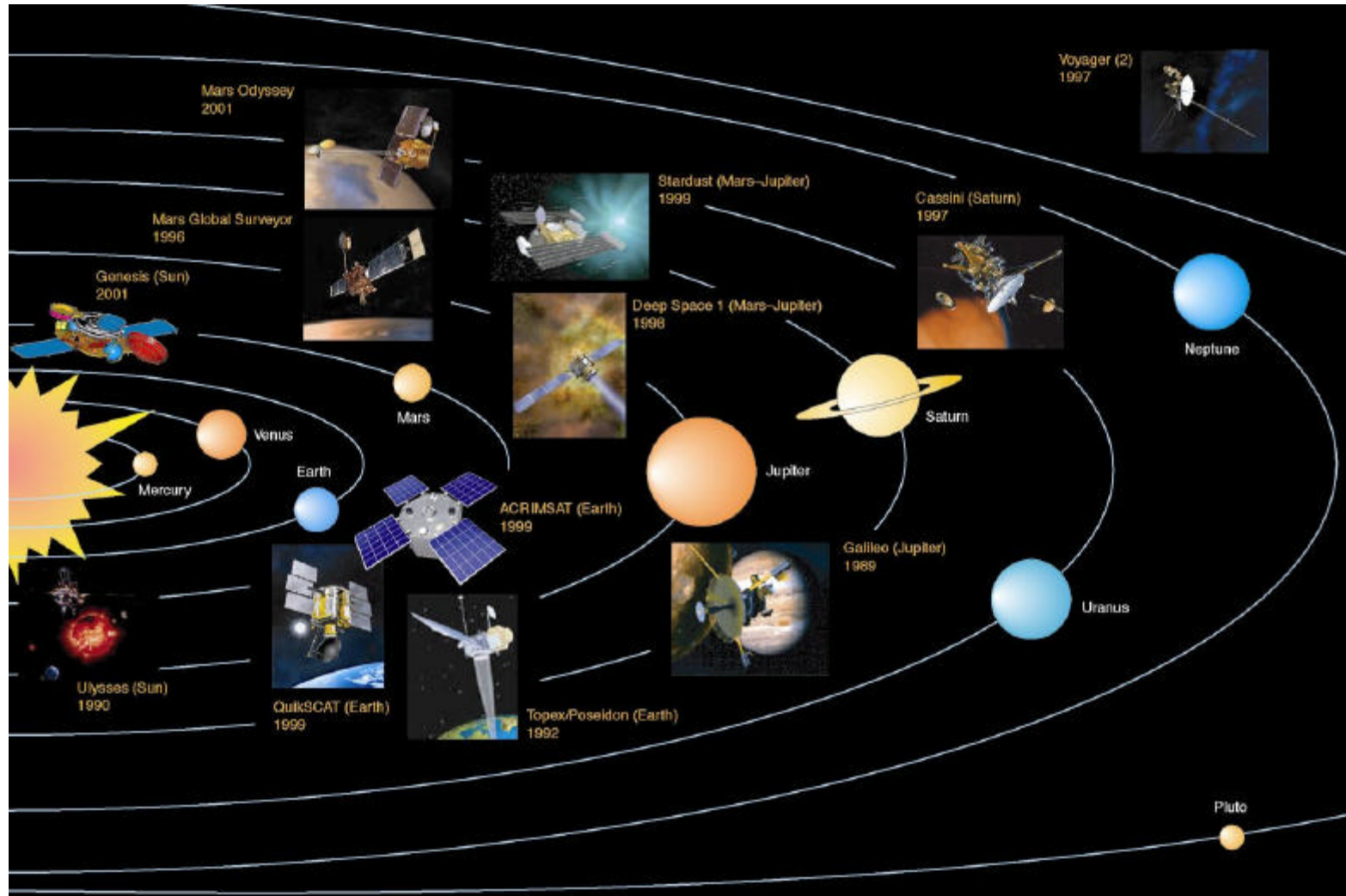
Genesis



Jason

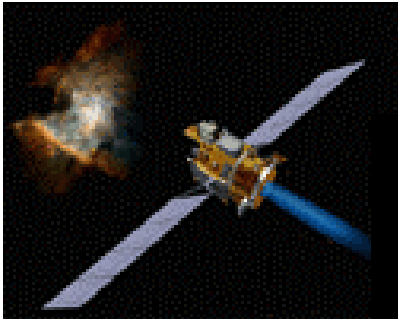
2001: Space Discovery [Fact]

JPL Missions Currently Flying

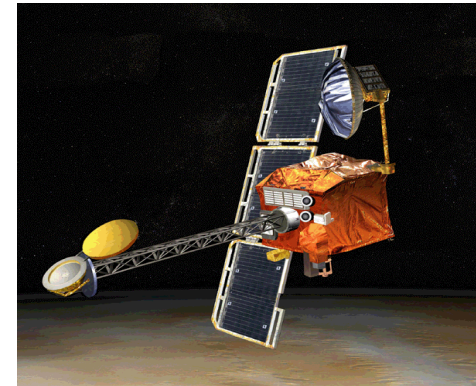


2001: Space Discovery

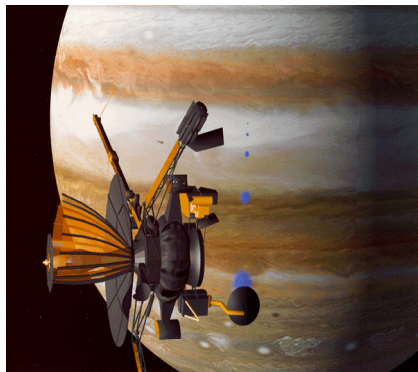
Highlights



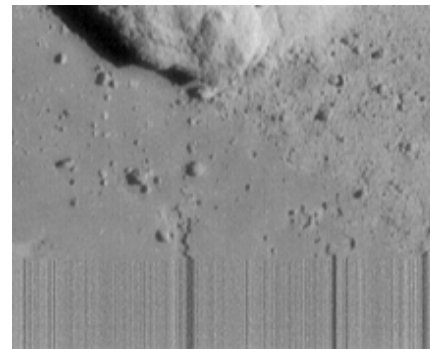
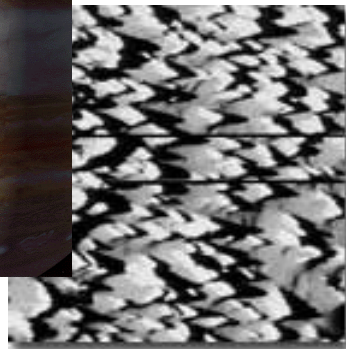
**Deep Space 1:
Encounter with
Comet Borrelly**



**Mars Odyssey:
Orbital insertion**



**Galileo:
Last Encounters with
Jovian Moons**

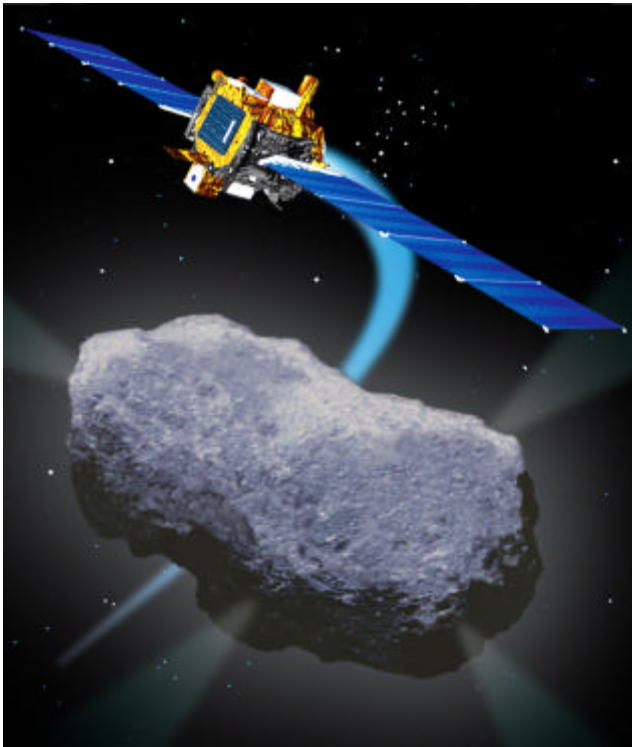


**NEAR (APL):
120 meter close-up
of Asteroid EROS**

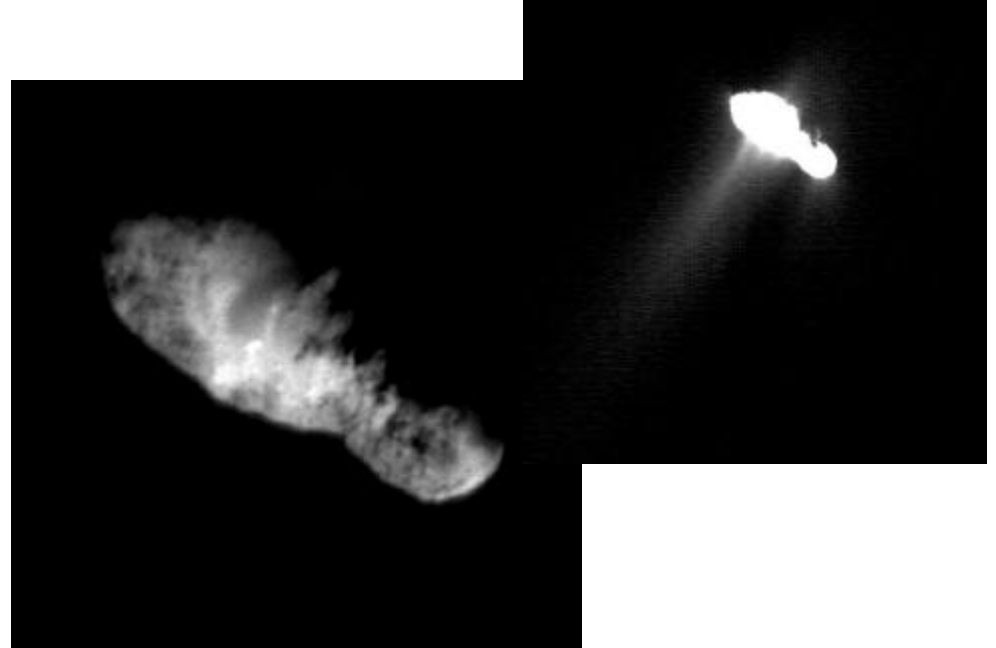


2001: Space Discovery

Deep Space 1: Encounter with Comet Borrelly

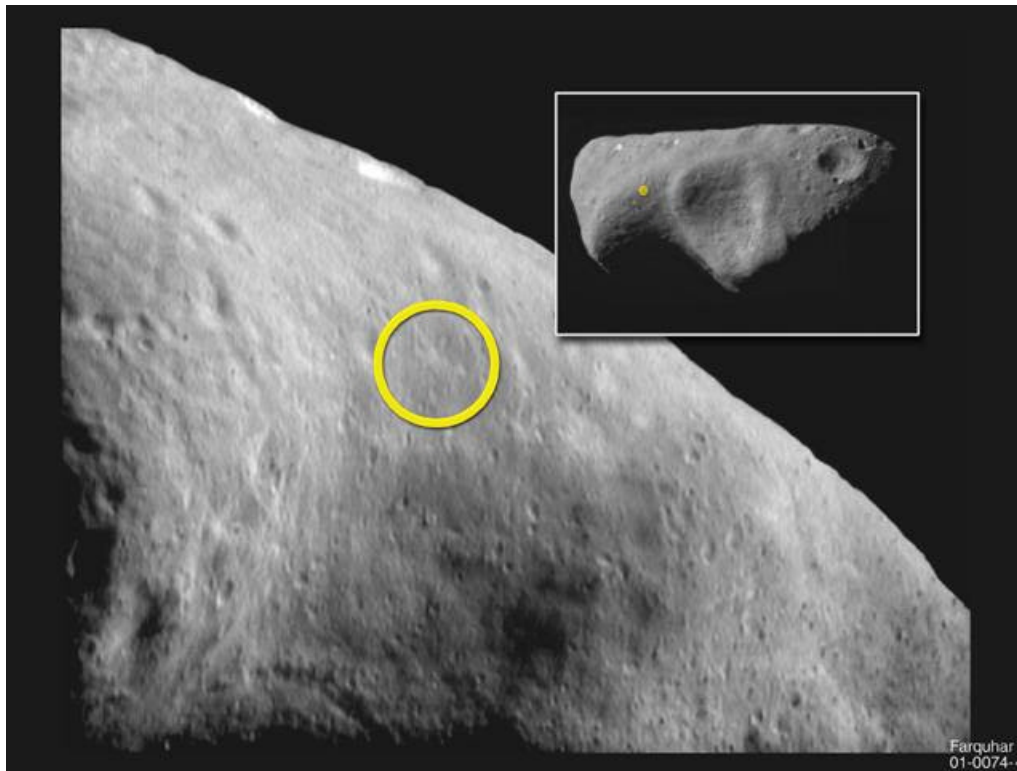


- ♦ Encounter with comet Borrelly on September 22, 2001.
- ♦ Best pictures ever of a comet nucleus
- ♦ High-risk conclusion of a two-year extended mission.
- ♦ Primary mission met or exceeded its success criteria in 1999.
- ♦ JPL/NASA's lowest-cost deep-space mission.
- ♦ Flight-demonstrated electric propulsion.

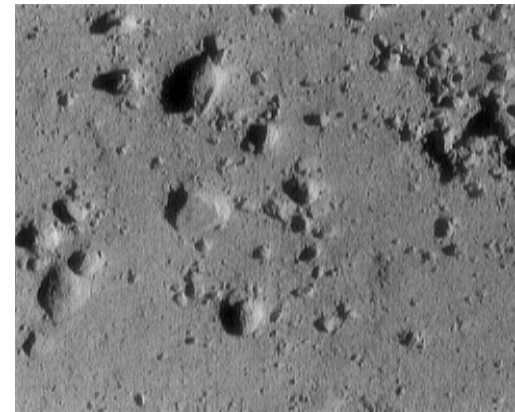


2001: Space Discovery

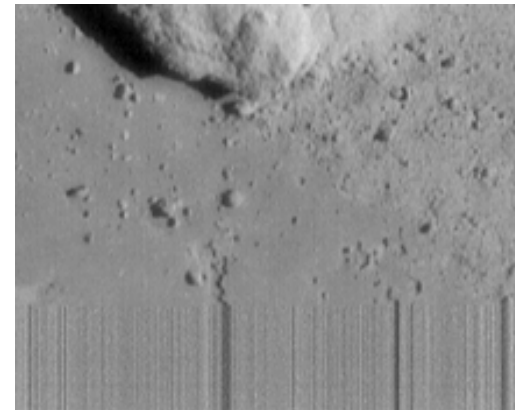
NEAR landing on Asteroid Eros



Eros landing site



Eros from 250 meters



Eros from 120 meters

2001: Space Discovery

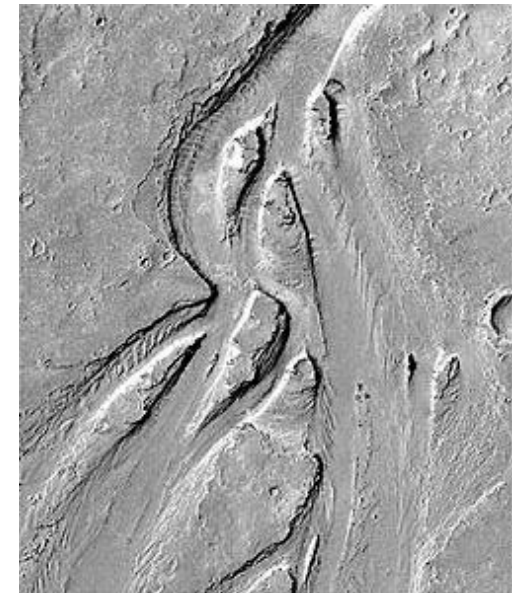
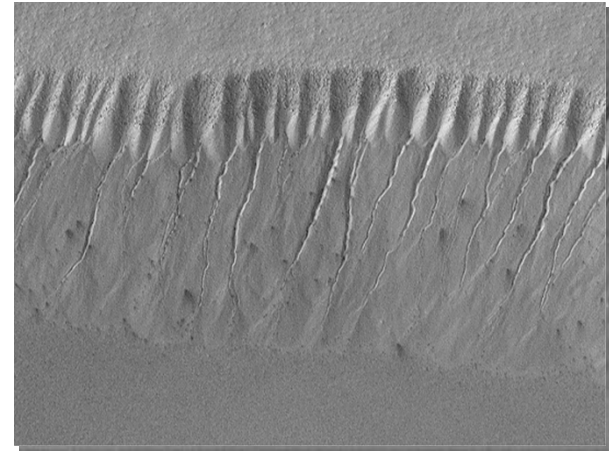
Exploration of Mars: Mars Global Surveyor

Evidence of Liquid Water

The New York Times

FEBRUARY 26, 2002

Signs of Great Floods, on Mars



2001/2: Space Discovery

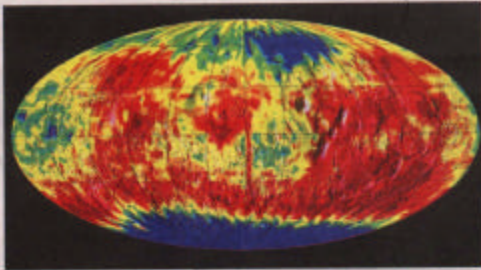
Exploration of Mars: Mars Odyssey

Where is the Water Now?

Los Angeles Times

SATURDAY, MARCH 2, 2002

Coverage 2001/2002/2003 Prices



NASA/Jet Propulsion Laboratory

This image of Mars was taken by a gamma ray spectrometer on the Odyssey craft. The south pole area, shown as blue, has high levels of hydrogen in the soil, indicating ice.

Vast Ice Fields Suggest Life on Mars Possible

Astronomy: Scientists say they are 'blown away' by the Odyssey spacecraft's findings.

By USHA LEE McFARLING
TIMES STAFF WRITER

Just days after starting its science mission, a new spacecraft orbiting Mars has struck pay dirt, detecting vast fields of ice that scientists say provide evidence of sufficient water to make it possible for the planet to have harbored life.

The discovery is a coup for NASA, whose leaders are using a "follow the water" strategy to understand the evolution of Mars and look for signs of past and present life there. The presence of water would also be key

to any future attempt to have astronauts explore the Martian surface.

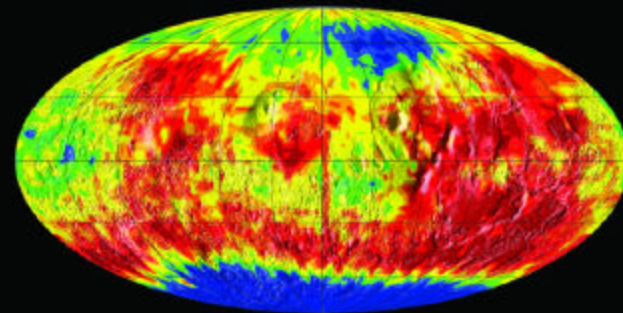
"Water is vital to life. Water has changed the surface of Mars in the past. And water is essential to the future exploration of Mars," R. Stephen Saunders, the Jet Propulsion Laboratory's project scientist for the Odyssey orbiter, said at a news conference Friday in Pasadena to release the findings.

Results from planetary missions often take months, if not years, to be collected, analyzed and released to the public. The new results are unusual because they come so early in the mission, "from the first few days, in some cases the first few hours, of exploration," Saunders said.

The normally cautious scientists were able to make strong

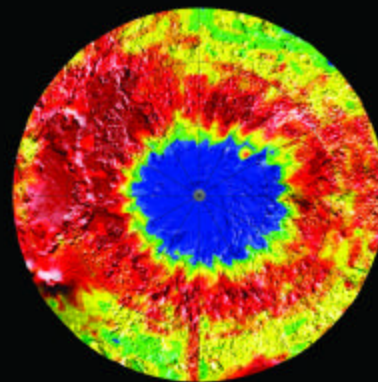
Please see MARS, A19

2 4 6 8 10 12
Epithermal Neutrons, counts per sec

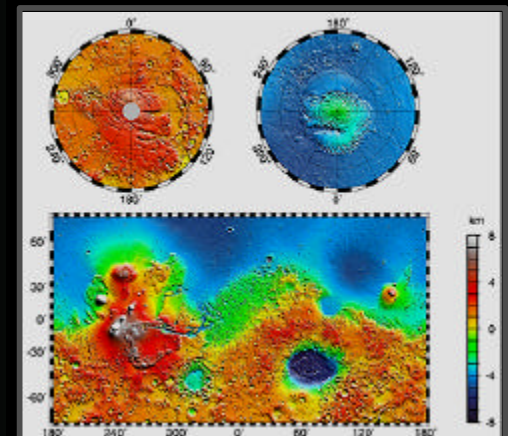


UNIT: 1000000000

Counts per sec
12
10
8
6
4
2
Epithermal Neutrons



UNIT: 1000000000

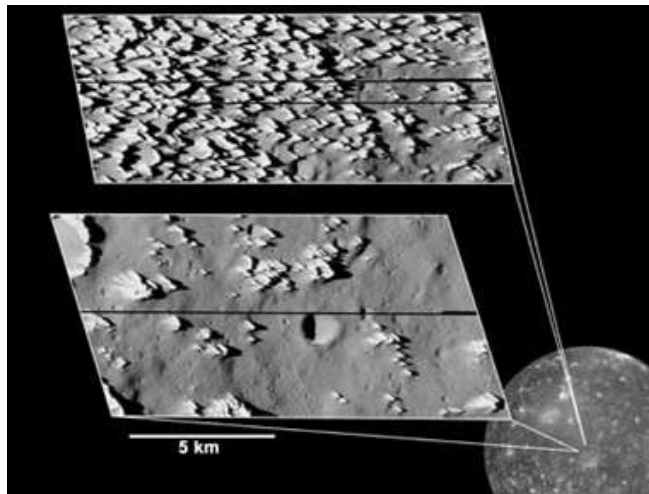


2001: Space Discovery

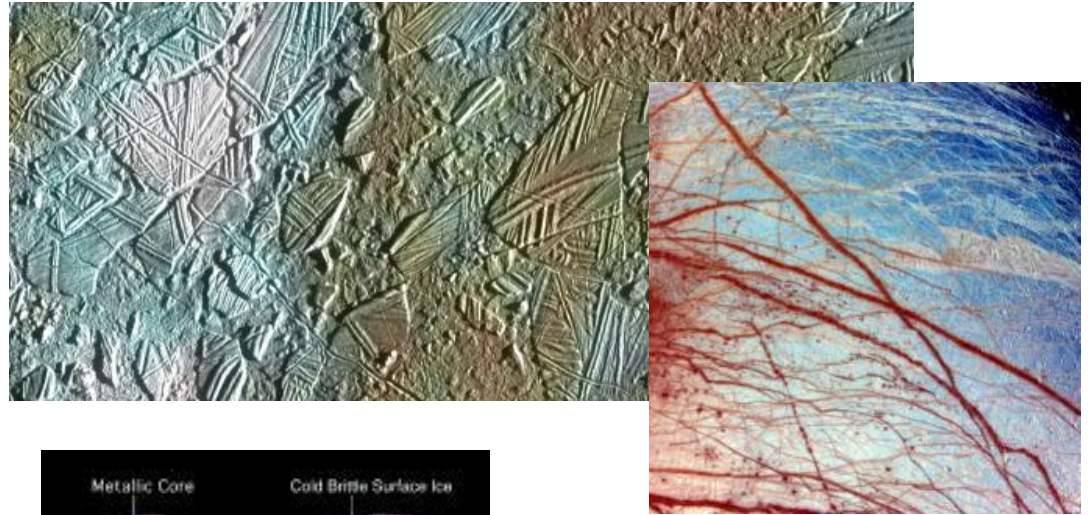
Exploration of the Outer Solar System

Galileo Science Highlights

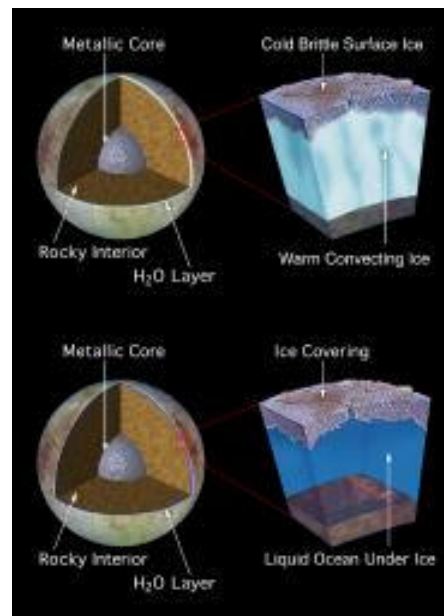
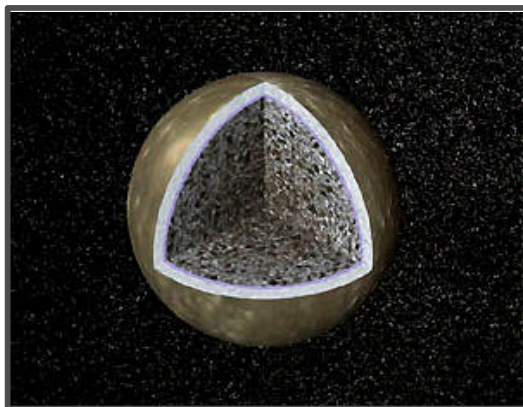
Callisto: Jagged Terrain



Europa: Active Surface

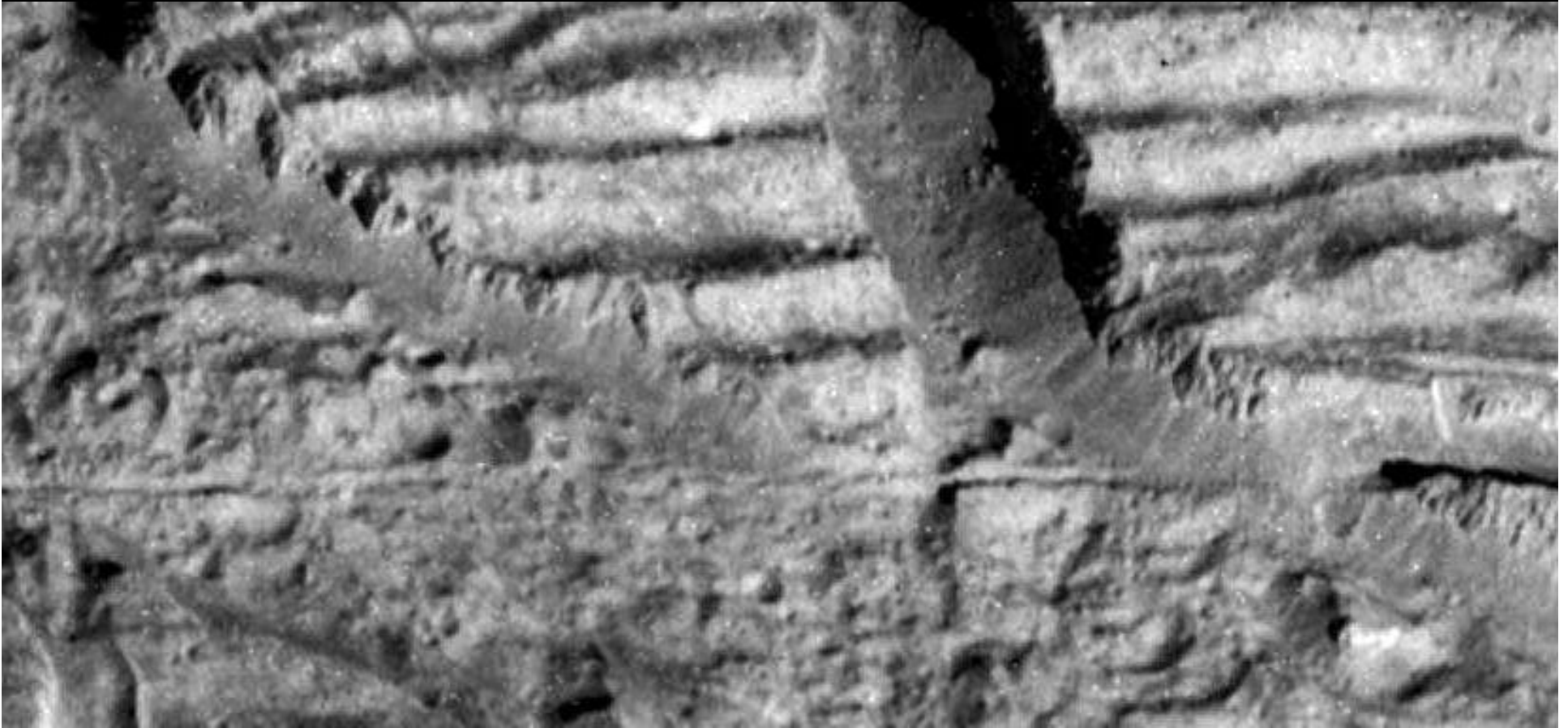


Possible Callisto Ocean

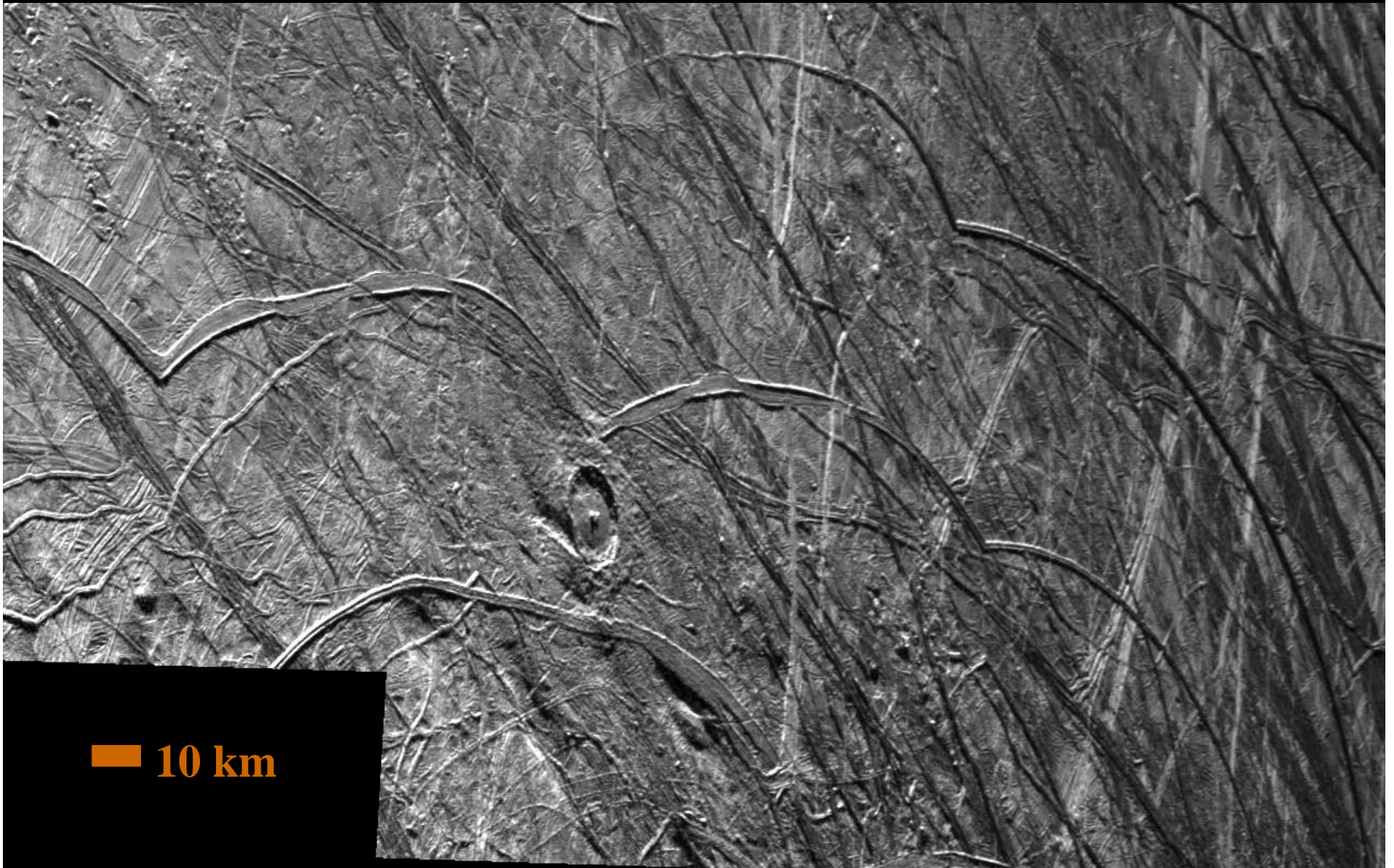


Europa Subsurface Ocean

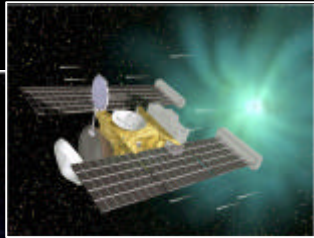
Europa



Europa: Cycloid Ridges

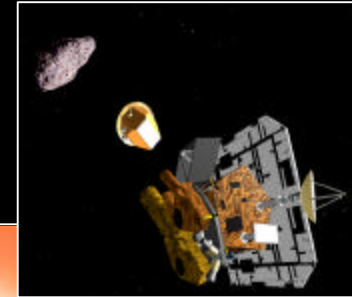


Next Steps: Sampling the Solar System

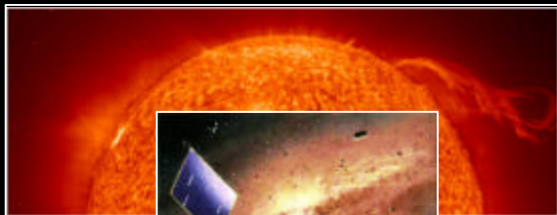
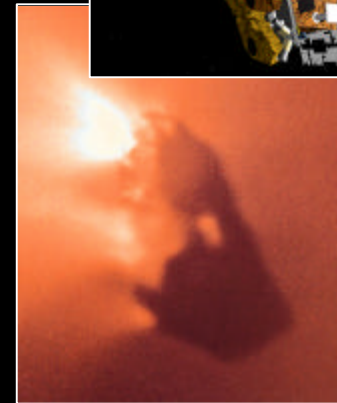


Stardust:
Comet
material
return

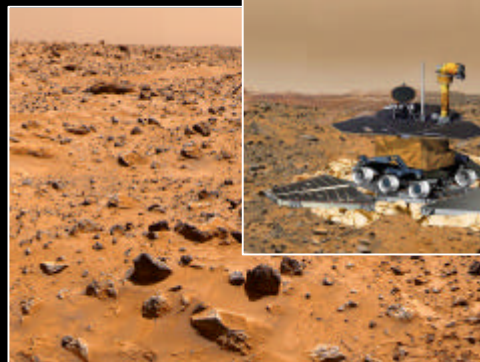
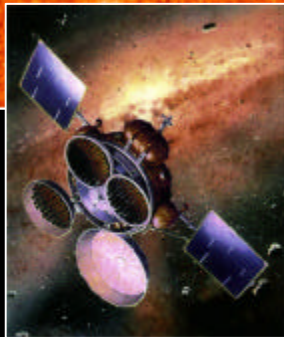
Titan in Situ



**Deep
Impact:**
Comet
penetrator



Genesis:
Solar wind
material
return

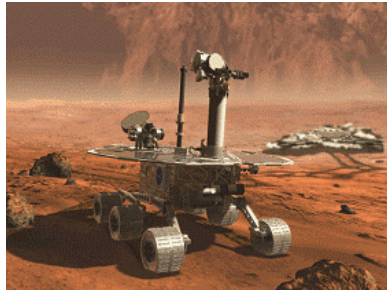


Mars in Situ

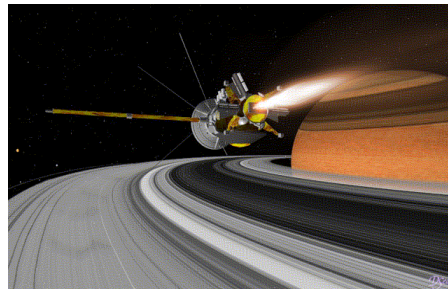


2004: A Space Bonanza

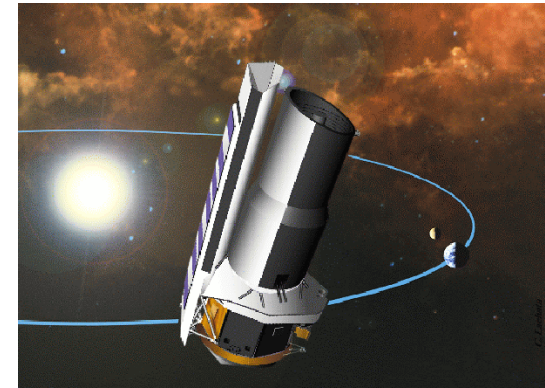
JPL Mission Highlights



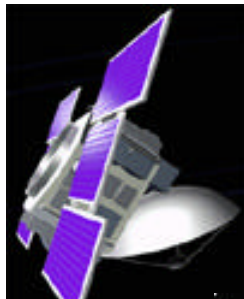
Mars Exploration Rovers
arrive on surface



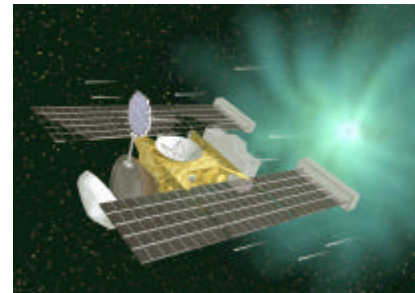
Cassini-Huygens arrives
at Saturn



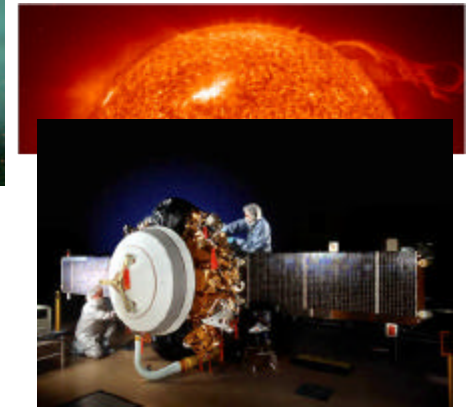
NASA infrared great
observatory SIRTIF in full
science operation



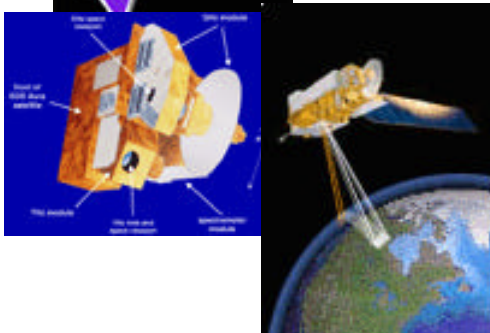
Earth satellites:
Cloudsat, Tropospheric
Emission Spectrometer,
Microwave Limb Sounder
in operation



Stardust captures
material from Comet



Genesis returns sample of
solar wind to earth

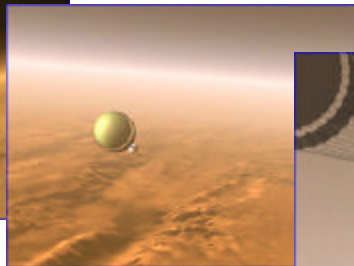
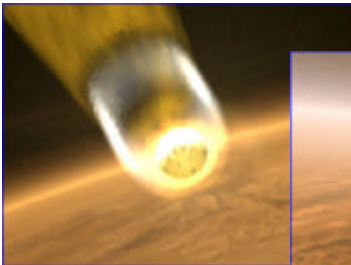
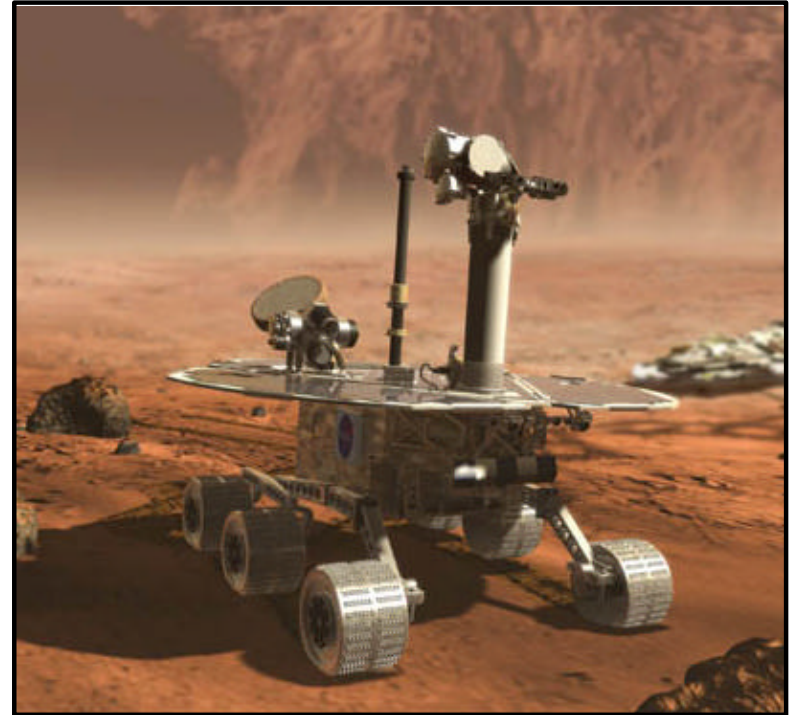
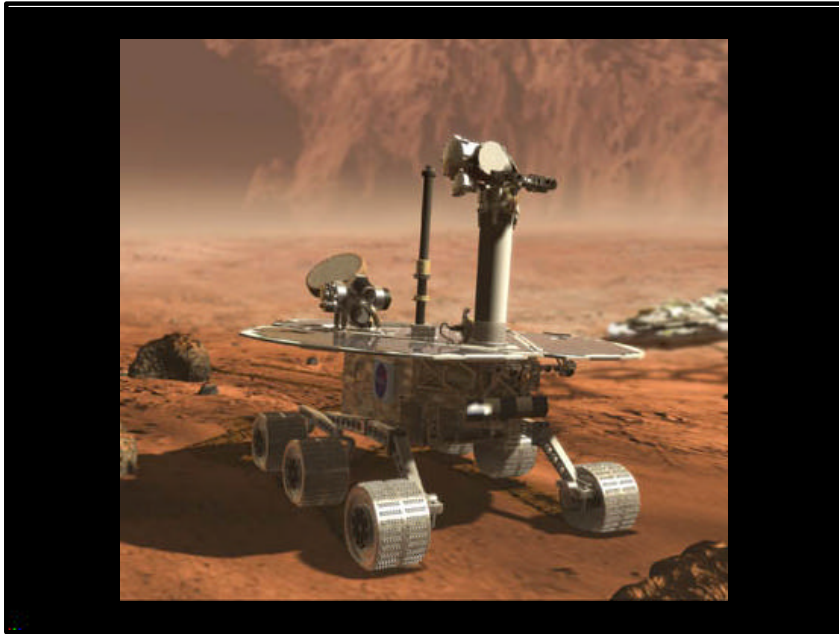


Deep Impact comet
penetrator launched



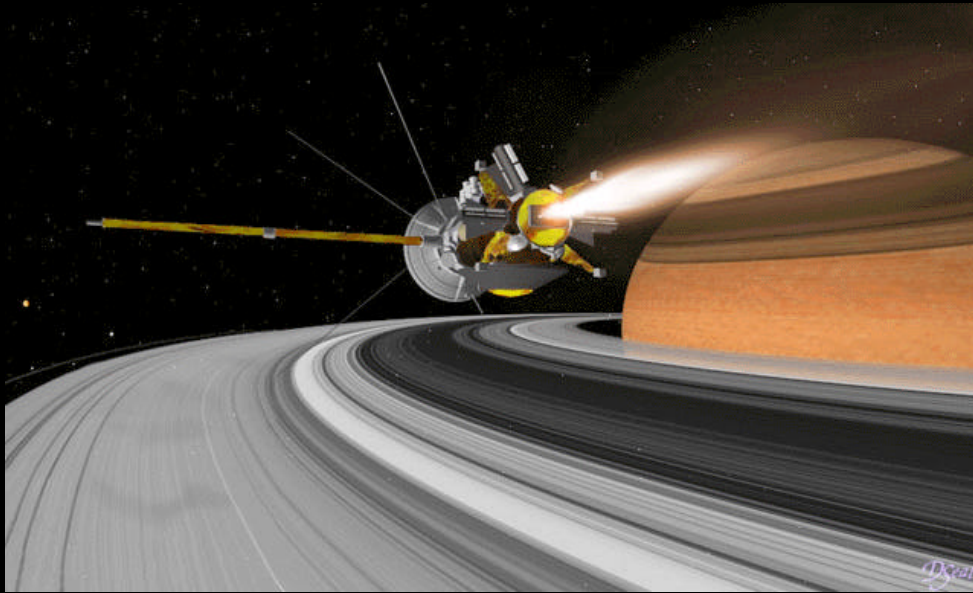
2004: A Space Bonanza

Mars Exploration Rovers



2004: A Space Bonanza

Cassini-Huygens to Saturn/Titan



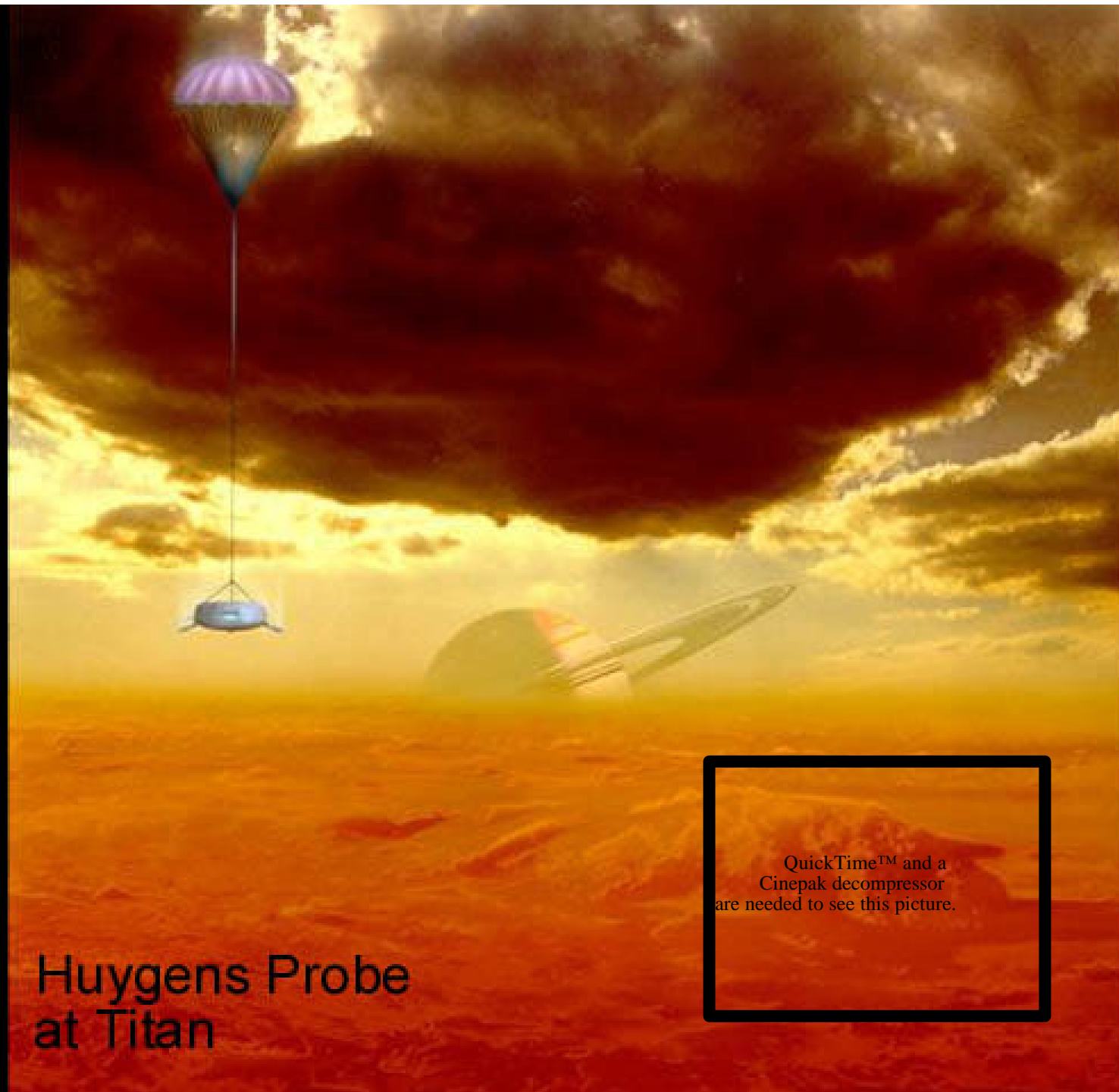
Titan
(Voyager)



Rings
(Voyager)



Huygens Probe
at Titan

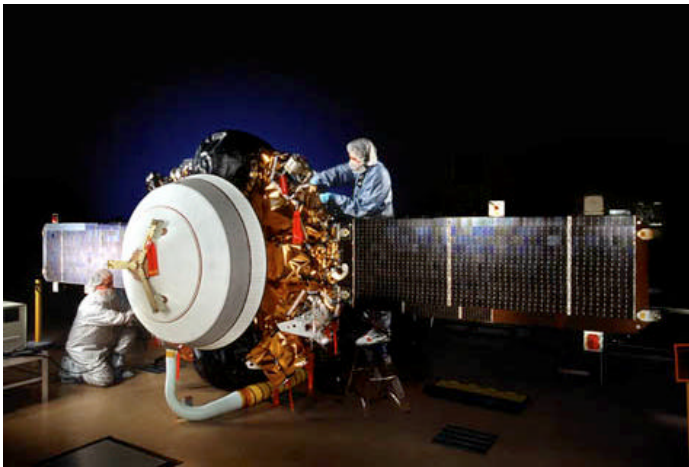


Huygens Probe at Titan

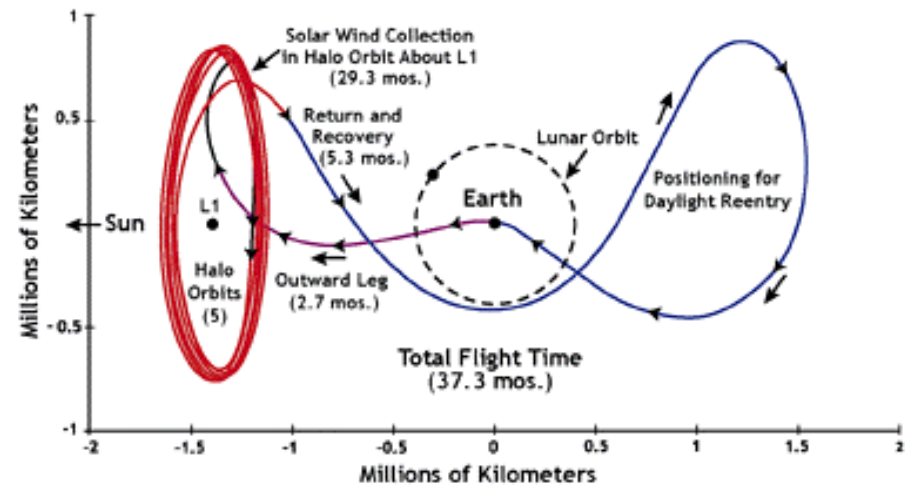
QuickTime™ and a
Cinepak decompressor
are needed to see this picture.

2004: A Space Bonanza

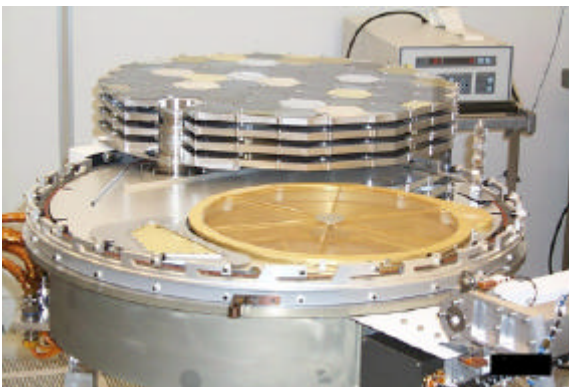
Genesis: Bringing a piece of the Sun back to Earth



Genesis Spacecraft



Genesis Mission Trajectory 2001–2004



Genesis Science Canister

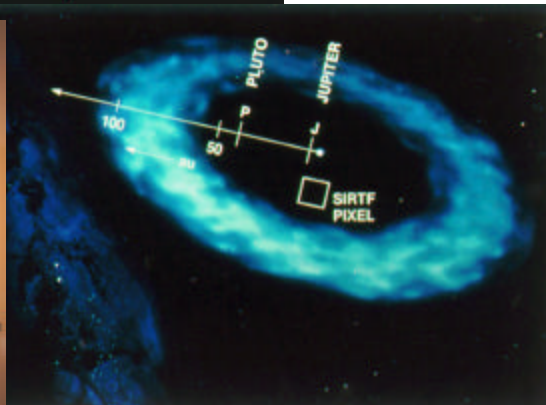
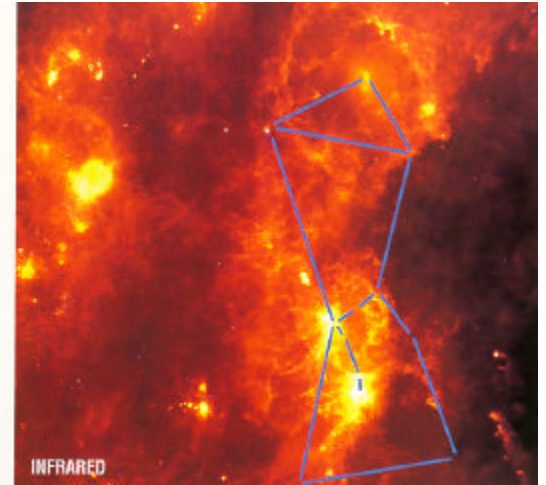
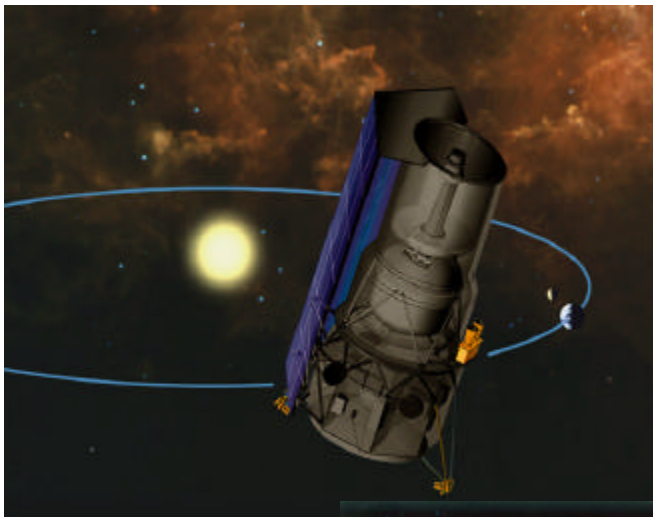
Launch: 08.08.2001

Sample Return: 09.2004

Principal Investigator: *Don Burnett,*
California Institute of Technology

2004: A Space Bonanza

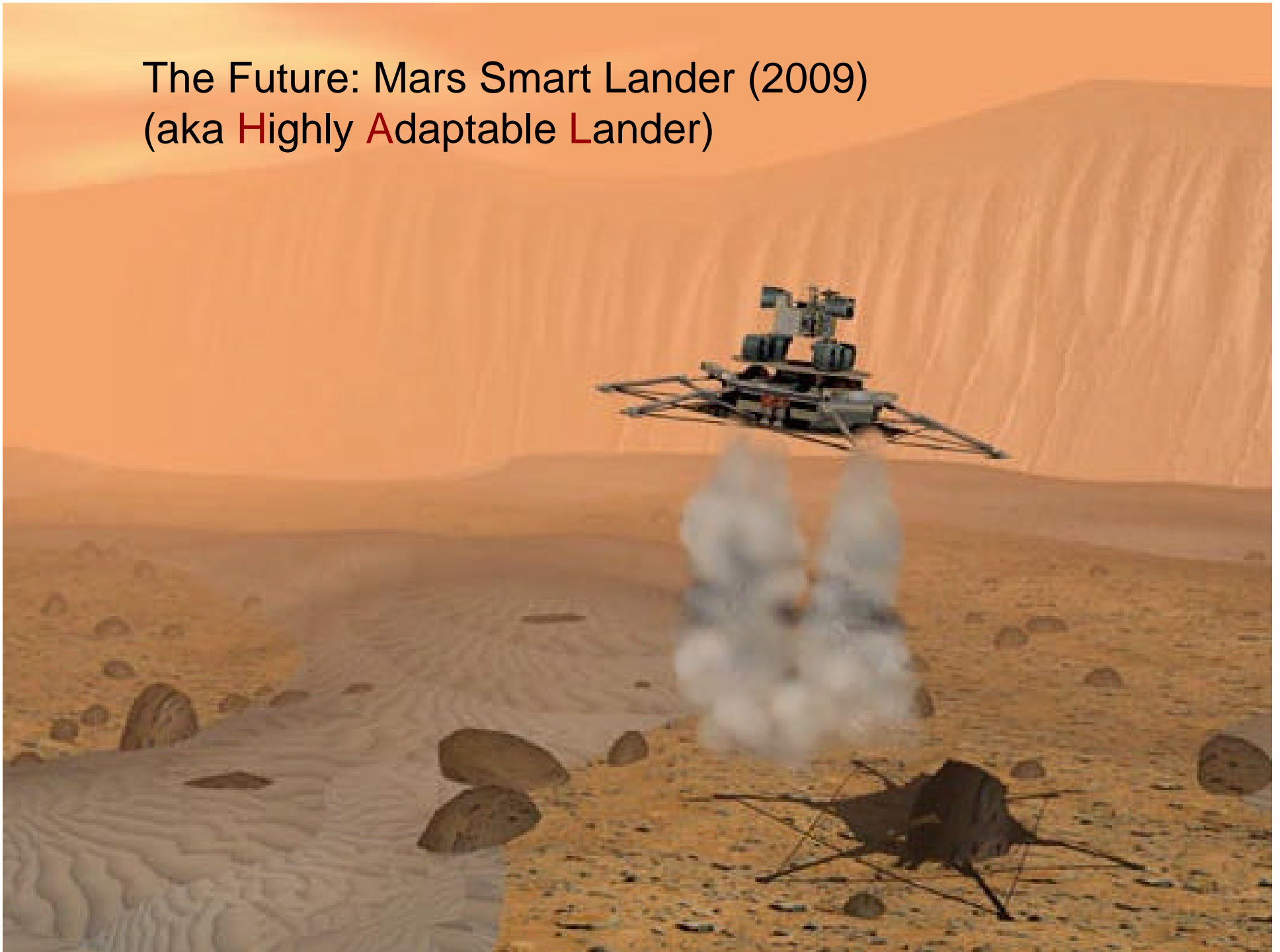
Space Infrared Telescope Facility (SIRTF)



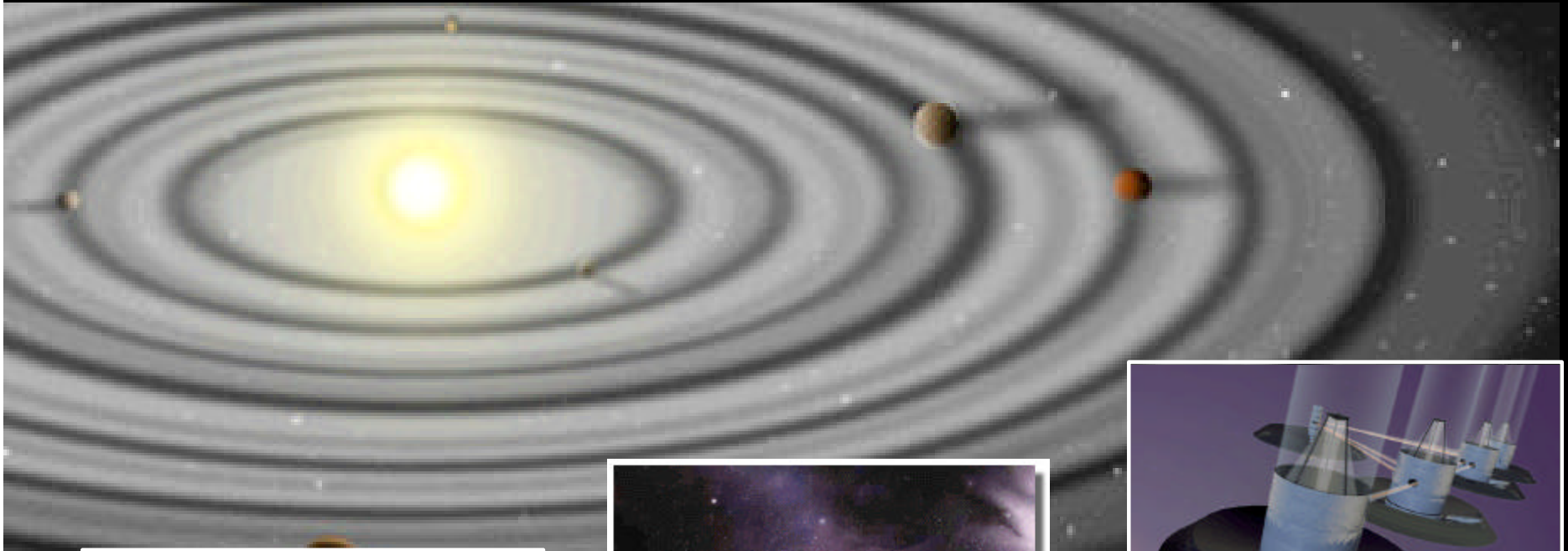
VEGA with Kuiper Belt

- ◆ 2.5- to 5-year mission.
- ◆ Completes NASA's Great Observatories.
- ◆ A cornerstone of the Origins Program.

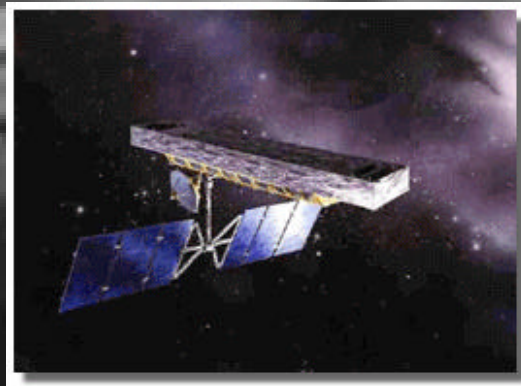
The Future: Mars Smart Lander (2009)
(aka **H**ighly **A**daptable **L**ander)



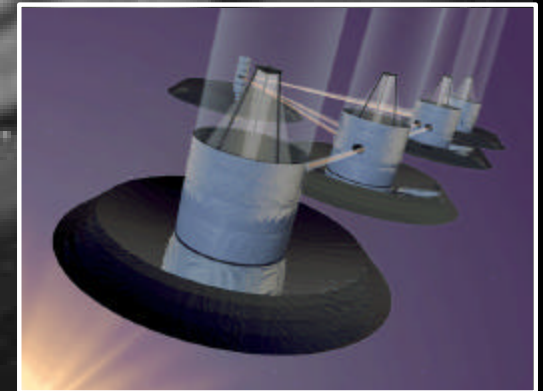
The Future: Searching for planets around neighboring stars



StarLight



**Space Interferometry
Mission**



**Terrestrial Planet
Finder**

... the future may be more interesting than
any fiction we can imagine

40 years of planetary exploration: 1962-2002

... the end